Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 1 of 15

FIG.1

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Dock t No. 16869P-006210US
Sheet 2 of 15

FIG.2

COMMAND NAME	PAIR STATUS		
	NO PAIR	PAIRED NOT COPIED	PAIRED AND COPIED
CREATE PAIR	CREATE NEW PAIR (231)	DO NOTHING (232)	DO NOTHING (233)
DELETE PAIR	DO NOTHING (241)	DELETE PAIR (242)	DELETE PAIR (243)
CREATE COPY (SPLIT OPERATION)	DO NOTHING (251)	INITIATE COPYING (252)	DO NOTHING (253)
RE-SYNCHRONIZE	DO NOTHING (261)	DO NOTHING (262)	INITIATE RE-SYNCHRO-NIZE COPY (263)

FIG.3

PAIR NUMBER	PAIR STATUS	PRIMARY VOLUME	SECONDARY VOLUME	COPY POINTER
1	PAIRED NOT COPIED	12	64	0
:	:	:	:	:

Applicant: Kouji ARAI, *et al.*
Titl : System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 3 f 15

FIG.4

TRACK   0123 4567 89AB CDEF

PAIR=0

PAIR=1

PAIR=2

0001 0000 0000 1111   401

:   :

0000 0000 0000 0000

FIG.5

COPY PROCESSING
INPUT = PAIR NUMBER   500

501

PAIR STATUS FOR THE INPUT PAIR = PAIRED AND COPY IN PROGRESS ?   No

Yes

INVOKE COPY PROCESS WITH PAIR # AS INPUT   502

503

DOES END POINTER = MAXIMUM ADDRESS OF LOGICAL VOLUME (i,e, DONE?)   No

Yes

PAIR STATUS FOR THE INPUT PAIR = " PAIRED AND COPIED " STATUS   504

END

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty D cket No. 16869P-006210US
Sheet 4 of 15

FIG.6

```
        ELEMENTAL COPY        600
          PROCESSING

     FETCH COPY POINTER        601

   SELECT DATA TRACKS HAVING
   INEQVALITY BIT=1 USING LOCATION   602
   INDICATED BT COPY POINTER

   READ DATA TO BE COPIED FROM
   PRIMARY VOLUME AND STORE IN    603
   CACHE MEMORY

   COPY DATA STORED IN 603 TO ANOTHER   604
   LOCATION WITHIN THE CACHE MEMORY

   WRITE COPIED DATA TO SECONDARY   605
   VOLUME

     RESET INEQVALITY BITS       609

   ADVANCE COPY POINTER TO MATCH
   DATA COPIED TO THE SECONDARY    606
   VOLUME

   SAVE MODIFIED COPY POINTER     607

            Return
```
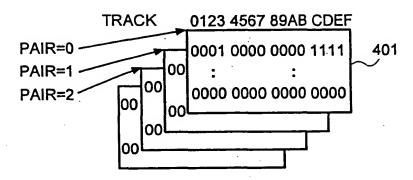
Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
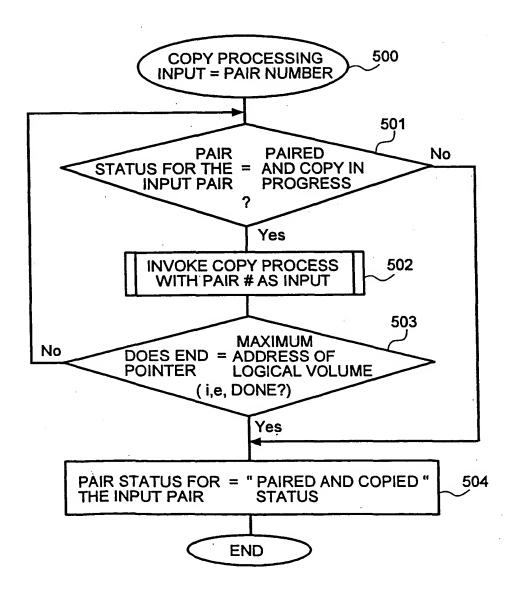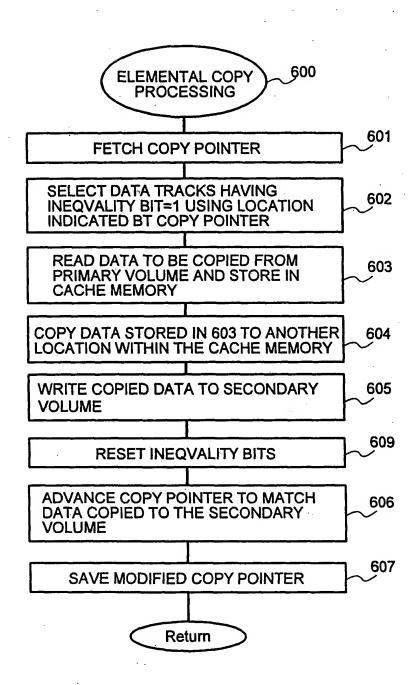Atty Docket No. 16869P-006210US
Sheet 5 of 15

FIG.7

701   702   703

| COMMAND CODE | PRIMARY VOLUME CODE | SECONDARY VOL. CODE |

700   COMMAND BLOCK

FIG.8

801

NO PAIR STATUS

211

CREATE PAIR
COMMAND

212

DELETE PAIR
COMMAND

802

PAIRED/
NOT COPED
STATUS

DELETE
PAIR CMD

212

214

RE-
SYNCHRONIZE
PAIR

804

PAIRED
AND COPIED
STATUS

213

CREATE COPY
COMMAND

212

DELETE
PAIR CMD

COPY PROCESSING
COMPLETE

500

803

PAIRED/
COPY IN PROGRESS
STATUS

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 6 of 15

FIG.9

PROCESSING CHANGE REQUEST
TO DATA ON PRIMARY VOLUME
DURING COPY PROCESSING —900

SEARCH FOR PAIR INFORMATION
CORRESPONDING TO INPUT NUMBER —901

902

CHK PAIR   "PAIRED &
STATUS OF = COPY IN   No
ENTRY   PROCESS"
?

Yes

903

CHK IF INEQUALITY   No
BIT=1
?

Yes

READ DATA TO BE MODIFIED FROM
PRIMARY VOLUME TO CACHE MEMORY —904

COPY THE DATA IN THE CACHE MEMORY —905

WRITE COPED DATA INTO SECONDARY
VOLUME —906

RESET INEQVALITY BIT TO ϕ —907

EXECUTE WRITE PROCESSING —909

END

Applicant: Kouji ARAI, et al.
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 7 of 15

FIG. 10A

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 8 of 15

Address Change Unit

1020

Buffer

1021

LA Exchange

② ③

1022

Cache

1022a

1022b

① ④

1024

1026

PDEV

PDEV

Data Structure

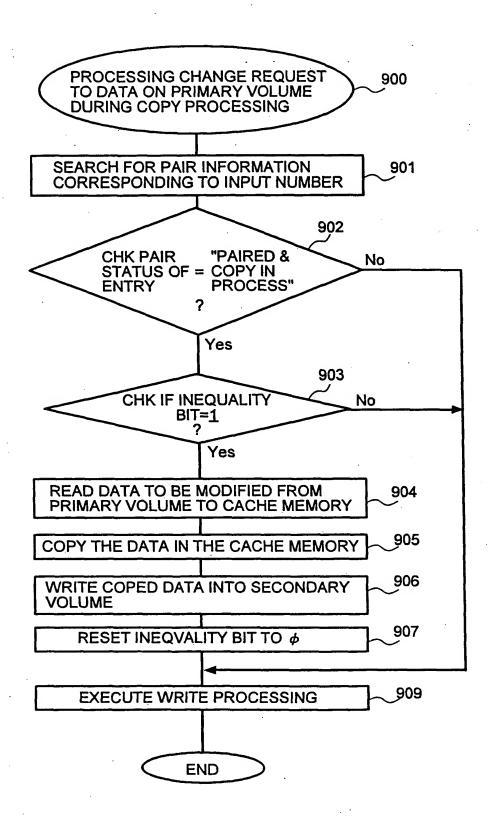1027   1029   1031

| Data | LA | CD |

DEV#

Check data for (Data + LA)

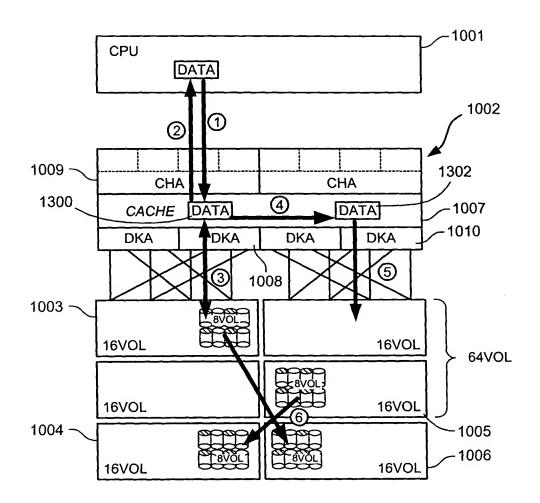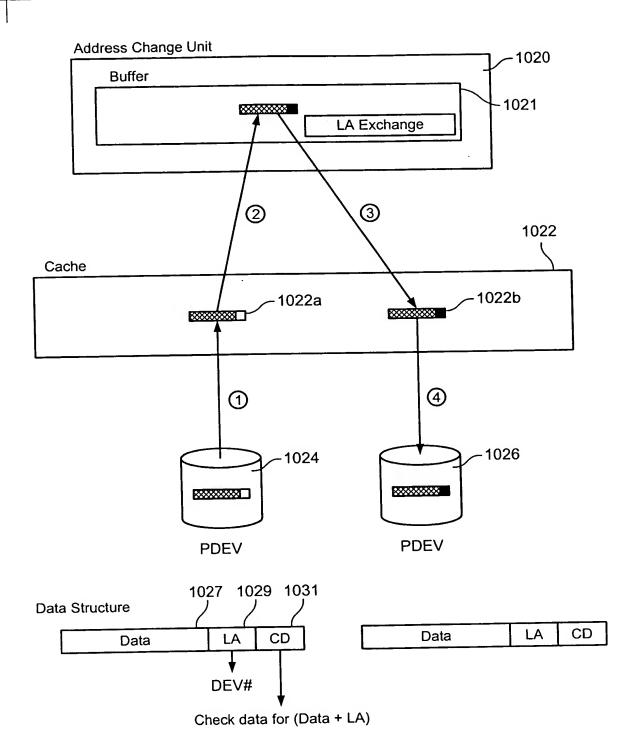| Data | LA | CD |

Data Section: User Data
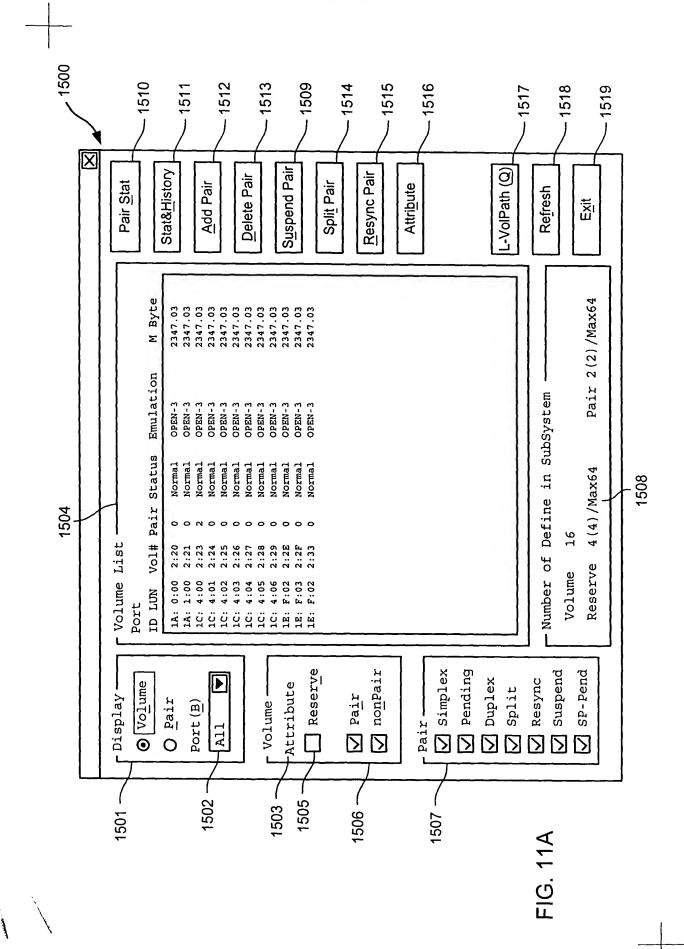LA Section: Logical Address for Data Section (DEV#)
CD Section: Check Code

FIG. 10B

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Dock t No. 16869P-006210US
Sheet 9 of 15

1500

Pair Stat — 1510

Stat&History — 1511

Add Pair — 1512

Delete Pair — 1513

Suspend Pair — 1509

Split Pair — 1514

Resync Pair — 1515

Attribute — 1516

L-VolPath (Q) — 1517

Refresh — 1518

Exit — 1519

1504

Volume List

Port

ID LUN	Vol#	Pair	Status	Emulation	M Byte
1A: 0:00	2:20	0	Normal	OPEN-3	2347.03
1A: 1:00	2:21	0	Normal	OPEN-3	2347.03
1C: 4:00	2:23	2	Normal	OPEN-3	2347.03
1C: 4:01	2:24	0	Normal	OPEN-3	2347.03
1C: 4:02	2:25	0	Normal	OPEN-3	2347.03
1C: 4:03	2:26	0	Normal	OPEN-3	2347.03
1C: 4:04	2:27	0	Normal	OPEN-3	2347.03
1C: 4:05	2:28	0	Normal	OPEN-3	2347.03
1C: 4:06	2:29	0	Normal	OPEN-3	2347.03
1E: F:02	2:2E	0	Normal	OPEN-3	2347.03
1E: F:03	2:2F	0	Normal	OPEN-3	2347.03
1E: F:02	2:33	0	Normal	OPEN-3	2347.03

Number of Define in SubSystem

Volume   16

Reserve   4(4)/Max64   Pair 2(2)/Max64

1508

Display — 1501

◉ Volume

○ Pair

Port (B) — 1502

All ▶

Volume — 1503

Attribute

☐ Reserve — 1505

☑ Pair

☑ nonPair — 1506

Pair — 1507

☑ Simplex

☑ Pending

☑ Duplex

☑ Split

☑ Resync

☑ Suspend

☑ SP-Pend

FIG. 11A

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sh et 10 f 15

1504

Volume List						
Port	S-Vol		Port	T-Vol		Pair
ID LWN	Vol#	Status	ID LUN	Vol#	Status	Status
1C:4:00	2:23	Normal	1E:F:00	2:2C	Normal	Duplex
1C:4:00	2:23	Normal	1E:F:01	2:2D	Normal	Duplex

FIG. 11B

Applicant: Kouji ARAI, et al.
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 11 of 15

FIG. 11C

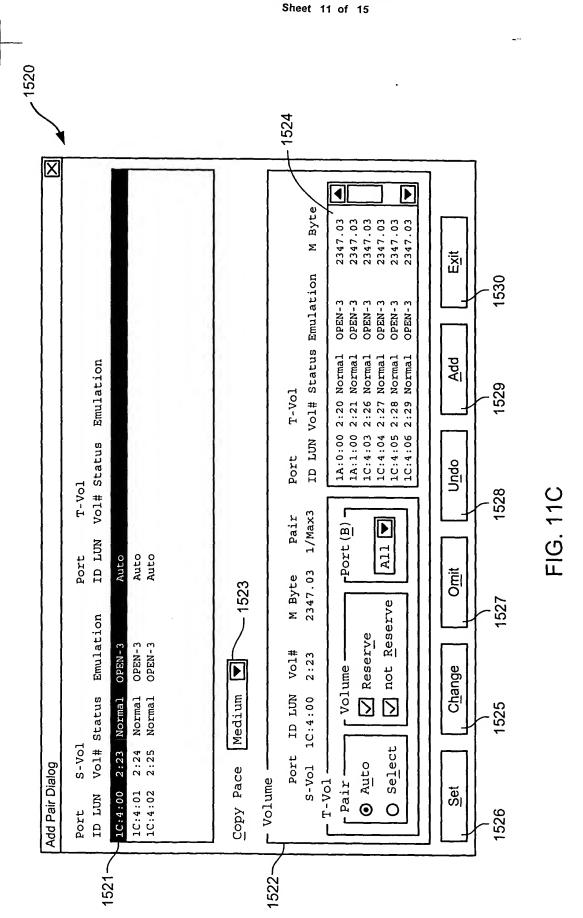Applicant: Kouji ARAI, et al.
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 12 of 15

FIG. 11D

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 13 of 15

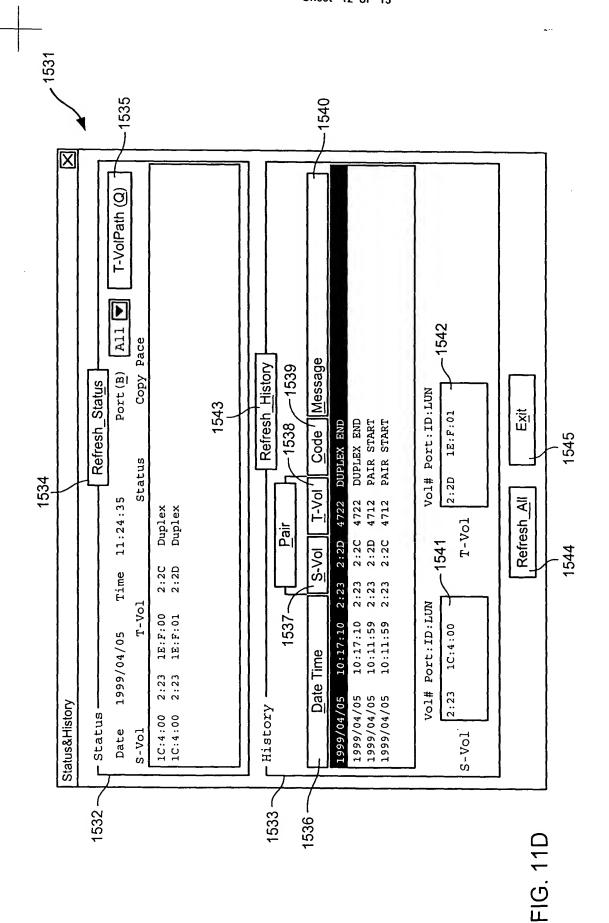1550

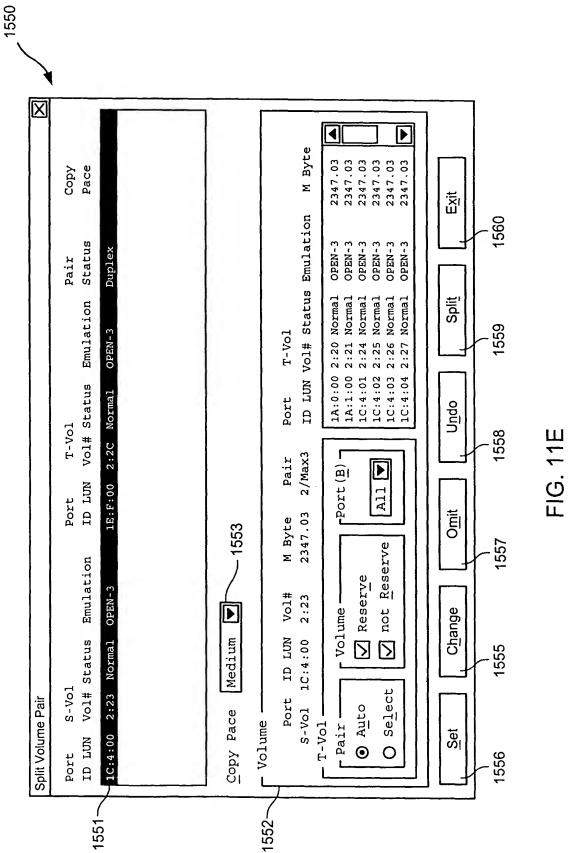## Split Volume Pair

Port ID LUN	S-Vol Vol#	Status	Emulation	Port ID LUN	T-Vol Vol#	Status	Emulation	Pair Status	Copy Pace
1C:4:00	2:23	Normal	OPEN-3	1E:F:00	2:2C	Normal	OPEN-3	Duplex	

1551

Copy Pace Medium ▶ — 1553

Volume

	Port ID LUN	Vol#	M Byte	Pair
S-Vol	1C:4:00	2:23	2347.03	2/Max3
T-Vol				

Pair
- ⦿ Auto
- ○ Select

Volume
- ☑ Reserve
- ☑ not Reserve

Port (B)
All ▶

Port ID LUN	T-Vol Vol#	Status	Emulation	M Byte
1A:0:00	2:20	Normal	OPEN-3	2347.03
1A:1:00	2:21	Normal	OPEN-3	2347.03
1C:4:01	2:24	Normal	OPEN-3	2347.03
1C:4:02	2:25	Normal	OPEN-3	2347.03
1C:4:03	2:26	Normal	OPEN-3	2347.03
1C:4:04	2:27	Normal	OPEN-3	2347.03

◀ ▶

1552

Set	Change	Omit	Undo	Split	Exit
1556	1555	1557	1558	1559	1560

FIG. 11E

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 14 of 15

1561

Resynchronize Volume Pair

Port	S-Vol			Port	T-Vol			Pair	Copy
ID LUN	Vol#	Status	Emulation	ID LUN	Vol#	Status	Emulation	Status	Pace
1C:4:00	2:23	Normal	OPEN-3	1E:F:00	2:2C	Normal	OPEN-3	Split	

1562

Copy Pace

Medium ▶

1563

Resync

1564

Exit

1565

FIG. 11F

Applicant: Kouji ARAI, *et al.*
Title: System and Method for Replicating Data
Atty Docket No. 16869P-006210US
Sheet 15 of 15

1571

Delete Volume Pair

Port ID LUN	S-Vol Vol#	Status	Emulation	Port ID LUN	T-Vol Vol#	Status	Emulation	Pair Status	Copy Pace
1C:4:00	2:23	Normal	OPEN-3	1E:F:00	2:2C	Normal	OPEN-3	Split	

1572

Delete 1574

Exit 1575

FIG. 11G